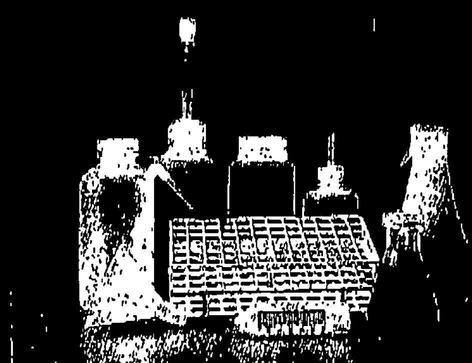
# NALGENE

## Labware 2000

www.nalgenunc.com



Catalogue 2

## Replacement Closures for NALGENE Bottles and Carboys

Refer to the Bottle Chart in this catalog to determine which closure fits your specific bottle.

| Bottle Neck Size | Description | Replacement Part No. | Pkg. Qty. |
|---|---|---|---|
| 13 mm | Screw Closure, PP | 71-2150-0130 | 12 |
| 13 mm | Amber Screw Closure, Amber PP | 71-2171-0130 | 12 |
| 13 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0130 | 2 |
| 20 mm | Screw Closure, PP | 71-2150-0200 | 12 |
| 20 mm | Screw Closure, HDPE | 71-2151-0200 | 12 |
| 20 mm | Screw Closure, Amber PP | 71-2171-0200 | 12 |
| 20 mm | Screw Closure, Teflon PFA* | 71-2172-0020 | 2 |
| 20 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0200 | 2 |
| 24 mm | Screw Closure, PP | 71-2150-0240 | 12 |
| 24 mm | Screw Closure, HDPE | 71-2151-0240 | 12 |
| 24 mm | Screw Closure, Amber PP | 71-2171-0240 | 12 |
| 24 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0240 | 2 |
| 28 mm | Screw Closure, PP | 71-2150-0280 | 12 |
| 28 mm | Screw Closure, HDPE | 71-2151-0280 | 12 |
| 28 mm | Screw Closure, Amber PP | 71-2171-0280 | 12 |
| 28 mm | Screw Closure, Black Tefzel ETFE* | 71-2173-0280 | 2 |
| 28 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0280 | 2 |
| 33 mm | Screw Closure, PP | 71-2150-0330 | 12 |
| 33 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0330 | 2 |
| 38 mm | Screw Closure, PP | 71-2150-0380 | 12 |
| 38 mm | Screw Closure, HDPE | 71-2151-0380 | 12 |
| 38 mm | Screw Closure, Amber PP | 71-2171-0380 | 12 |
| 38 mm | Screw Closure, Black Tefzel ETFE* | 71-2173-0380 | 2 |
| 38 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0380 | 2 |
| 38-430 | Screw Closure, HDPE | 71-2151-0384 | 12 |
| 38-430 | Screw Closure, PP | 71-2160-0384 | 12 |
| 38-430 | Screw Closure, Amber PP | 71-2171-0384 | 12 |
| 38-430 | Screw Closure, Teflon PFA* | 71-2172-0384 | 2 |
| 38-430 | Screw Closure, Natural Tefzel ETFE* | 71-2174-0384 | 2 |
| 43 mm | Screw Closure, PP | 71-2150-0430 | 12 |
| 43 mm | Screw Closure, Amber PP | 71-2171-0430 | 12 |
| 43 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0430 | 2 |
| 48 mm | Screw Closure, PP | 71-2150-0480 | 12 |
| 48 mm | Screw Closure, Amber PP | 71-2171-0480 | 12 |
| 48 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0480 | 2 |
| 53B | Screw Closure, HDPE | 71-2151-0053 | 12 |
| 53B | Screw Closure, PP | 71-2160-0530 | 12 |
| 53B | Screw Closure, Amber PP | 71-2171-0530 | 12 |
| 53 mm | Screw Closure, PP | 71-2150-0530 | 12 |
| 53 mm | Screw Closure, Natural Tefzel ETFE* | 71-2174-0530 | 2 |
| 63 mm | Screw Closure, PP | 71-2150-0630 | 12 |
| 63B | Screw Closure, Amber PP | 71-2171-0630 | 12 |
| 70 mm | Screw Closure, HDPE | 71-2151-0070 | 2 |
| 70 mm | Mason Jar Closure, White PP | 71-2154-0700 | 12 |
| 83B | Screw Closure, HDPE | 71-2151-0083 | 2 |
| 83B | Screw Closure, PP | 71-2160-0830 | 2 |
| 100 mm | Screw Closure, PP | 71-2150-1000 | 12 |
| 120 mm | Large Jar Closure, White PP | 71-2155-1200 | 12 |

*or equivalent. Teflon and Tefzel are registered trademarks of DuPont.

## Resins - Reference

### POLYOLEFINS

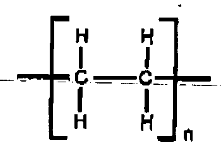
Polyolefins are high-molecular-weight hydrocarbons. They include: low-density, linear low-density and high-density polyethylene; polypropylene copolymer; polypropylene, and polymethylpentene. All are nontoxic and non-contaminating and exhibit varying degrees of break resistance. These are the only plastics lighter than water. They easily withstand exposure to nearly all chemicals at room temperature for up to 24 hours. Strong oxidizing agents eventually cause embrittlement. All polyolefins can be damaged by long exposure to ultraviolet light.

**Polyethylene** The polymerization of ethylene results in an essentially straight-chain, high-molecular-weight hydrocarbon. The polyethylenes are classified according to the relative degree of branching (side chain formation) in their molecular structures, which can be controlled with selective catalysts.

Like other polyolefins, the polyethylenes are chemically inert. Strong oxidizing agents will eventually cause oxidation and embrittlement. They have no known solvent at room temperature. Aggressive solvents will cause softening or swelling, but these effects are normally reversible.

**Low-density polyethylene (LDPE)** has more extensive branching, resulting in a less compact molecular structure.

**High-density polyethylene (HDPE)** has minimal branching, which makes it more rigid and less permeable than LDPE.

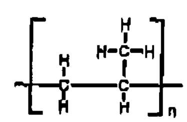


HIGH-DENSITY POLYETHYLENE

**Linear low-density polyethylene (LLDPE)** combines the toughness of low-density polyethylene with the rigidity of high-density polyethylene.

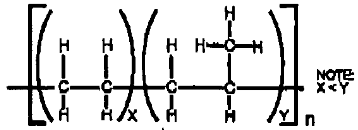
**Cross-linked high-density polyethylene (XLPE)** is a form of high-density polyethylene wherein the individual molecular chains are bonded to each other (using heat, plus chemicals or radiation) to form a three-dimensional polymer of extremely high molecular weight. This structure provides superior stress-crack resistance and somewhat improves the toughness, stiffness and chemical resistance of HDPE. XLPE is a superior material for molding very large storage tanks.

**Polypropylene (PP)** is similar to polyethylene, but each unit of the chain has a methyl group attached. It is translucent, autoclavable and has no known solvent at room temperature. It is slightly more susceptible than polyethylene to strong oxidizing agents. It offers the best stress-crack resistance of the polyolefins. Products made of polypropylene are brittle at 0°C and may crack or break if dropped from benchtop height.



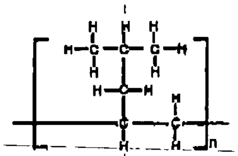
POLYPROPYLENE

**Polypropylene copolymer (PPCO)** replaces polyallomer (PA) and is an essentially linear copolymer with repeated sequences of ethylene and propylene. It combines some of the advantages of both polymers. PPCO is autoclavable and offers much of the high-temperature performance of polypropylene. It also provides some of the low-temperature strength and flexibility of polyethylene.



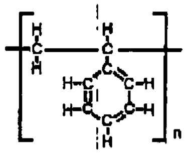

POLYPROPYLENE COPOLYMER

**Polymethylpentene (PMP or TPX†)** is similar to polypropylene, but it has an isobutyl group instead of a methyl group attached to each monomer group of the chain. Its chemical resistance is close to that of PP. It is more easily softened by unsaturated and aromatic hydrocarbons, and chlorinated solvents. PMP is slightly more susceptible than PP to attack by oxidizing agents. Its excellent transparency, rigidity and resistance to chemicals and high temperatures make PMP a superior material for labware. PMP withstands repeated autoclaving, even at 150°C. It can withstand intermittent exposure to temperatures as high as 175°C. Products made of polymethylpentene are brittle at ambient temperature and may crack or break if dropped from benchtop height.



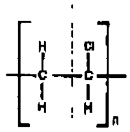
POLYMETHYLPENTENE

**Polystyrene (PS)** is rigid and non-toxic, with excellent dimensional stability and good chemical resistance to aqueous solutions, but limited resistance to solvents. This glass-clear material is commonly used for disposable laboratory products. Products made of polystyrene are brittle at ambient temperature and may crack or break if dropped from benchtop height.



POLYSTYRENE

**Polyvinyl Chloride (PVC)** is similar in structure to polyethylene, but each unit contains a chlorine atom. The chlorine atom renders it vulnerable to some solvents, but also makes it more resistant in many applications. PVC has extremely good resistance to oils (except essential oils) and very low permeability to most gases. Polyvinyl chloride is transparent and has a slight bluish tint. Narrow-mouth bottles made of this material are relatively thin-walled and can be flexed slightly. When blended with phthalate ester plasticizers, PVC becomes soft and pliable and can be extruded into flexible tubing.



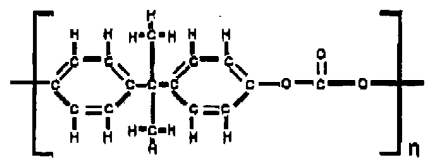
POLYVINYL CHLORIDE

**Thermoplastic elastomer (TPE)** is a type of polyolefin which, due to structure, molecular weight and chemistry, can be molded into autoclavable parts which are rubber-like in application and performance. It is used for several small caps and plugs on filtration and ultracentrifuge ware products.

## ENGINEERING RESINS

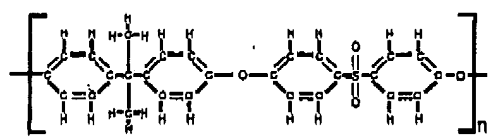
These resins offer exceptional strength and durability in demanding lab applications. For specific uses, they are superior to the polyolefins. Typical products are centrifuge ware, filterware and safety shields.

**Polycarbonate (PC)** is window-clear, amazingly strong and rigid. It is autoclavable, nontoxic and the toughest of all thermoplastics. PC is a special type of polyester in which dihydric phenols are joined through carbonate linkages. These linkages are subject to chemical reaction with bases and concentrated acids and hydrolytic attack at elevated temperatures (e.g., during autoclaving). This makes PC soluable in various organic solvents. For many applications, the transparency and unusual strength of PC offset these limitations. Its strength and dimensional stability make it ideal for high-speed centrifuge ware. Spectrophotometric analysis shows that the polycarbonate used in NALGENE safety products is essentially opaque to ultraviolet light from 200 to 380 nanometers (nm): 0% transmittance from 200-300 nm, 0.2% transmittance up to 380 nm. This covers the wavelengths emitted for germicidal applications such as laminar flow hoods (254 nm) and for fluorescence detection of dyes in electrophoresis or chromatography developing (350-360 nm).



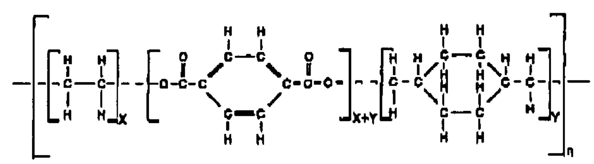
POLYCARBONATE

**Polysulfone (PSF)** Like polycarbonate, PSF is clear, strong, non-toxic and extremely tough. PSF is less subject than PC to hydrolytic attack during autoclaving and has a natural straw-colored cast. PSF is resistant to acids, bases, aqueous solutions, aliphatic hydrocarbons and alcohols. PSF is composed of phenylene units linked by three different chemical groups – isopropylidene, ether and sulfone. Each of the three linkages imparts specific properties to the polymer, such as chemical resistance, temperature resistance and impact strength.



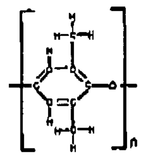
POLYSULFONE

**Polyethylene Terephthalate G Copolyester (PETG)** is similar to many other engineering resins. However, its glass-like clarity, toughness and excellent gas-barrier properties make it an outstanding choice for storing biologicals. Tests have shown PETG to be biologically equivalent to, or better than, Type I borosilicate glass bottles for cell culture applications. In tests using a wide variety of cell lines, PETG was determined to be non-cytotoxic, and media stored in PETG bottles demonstrated proliferative and morphological characteristics comparable to control media. In fact, the PETG bottles allowed growth of good monolayers directly on the surface of the bottle. PETG can be sterilized with radiation or compatible chemicals but cannot be autoclaved. Its chemical resistance is fair.



POLYETHYLENE TEREPHTHALATE G COPOLYESTER

**Polyphenylene Oxides (PPO)** A patented process for oxidative coupling of phenolic monomers is used to forumlate Noryl' phenylene oxide-based thermoplastic resins. This family of engineering materials is characterized by outstanding dimensional stability at elevated temperatures, broad temperature-use range, outstanding hydrolytic stability and excellent dielectric properties over a wide range of frequencies and temperatures. Among their design advantages are: (1) excellent mechanical properties over temperatures from below -40°C (-40°F) to above 48°C (300°F); (2) self-extinguishing, non-dripping characteristics; (3) excellent dimensional stability and low water absorption; (4) resistance to aqueous chemical environments, and (5) excellent impact strength.



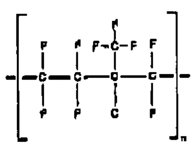
PHENYLENE OXIDE

## FLUOROCARBONS

Typical fluorocarbons are Teflon tetrafluoroethylene (TFE)* and Teflon fluorinated ethylene propylene (FEP)*. Both have remarkable chemical resistance.

**Teflon TFE*** is opaque white and has the lowest coefficient of friction of any solid. It makes superior stopcock and separatory funnel plugs.

**Teflon FEP*** is translucent, flexible and feels heavy because of its high density. It resists all known chemicals except molten alkali metals, elemental fluorine and fluorine precursors at elevated temperatures. It should not be used with concentrated perchloric acid. FEP withstands temperatures from -270°C to +205°C and may be sterilized repeatedly by all known chemical and thermal methods. It can even be boiled in nitric acid.

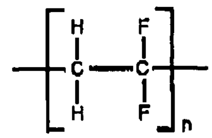


TEFLON FEP

**Tefzel ETFE*** is translucent white and slightly flexible. It is a close analog of Teflon* fluorocarbons, an ethylene tetrafluoroethylene copolymer. ETFE shares the remarkable chemical and temperature resistance of Teflon TFE* and FEP* and has even greater mechanical strength and impact resistance.

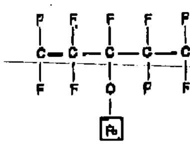
**Halar ECTFE**** is an alternating copolymer of ethylene and chlorotrifluoroethylene. This fluoropolymer withstands continuous exposure to extreme temperatures and maintains excellent mechanical properties across this entire range (from cryogenic temperatures to 180°C). It has excellent electrical properties and chemical resistance and has no known solvent at 121°C. It is also non-burning and radiation-resistant. Its ease of processing makes it suitable for a wide range of products.

**Polyvinylidene Fluoride (PVDF, best known as Kynar***)** is a fluoropolymer with alternating CH2 and CF2 groups. PVDF is an opaque white resin. Extremely pure, it is superior for non-contaminating applications. Mechanical strength and abrasion resistance are high, similar to ECTFE. It resists UV radiation. The maximum service temperature for rotationally-molded PVDF tanks is 100°C. Up to this temperature, PVDF has excellent chemical resistance to weak bases and salts, strong acids, liquid halogens, strong oxidizing agents and aromatic, halogenated and aliphatic solvents. However, organic bases and short-chain ketones, esters and oxygenated solvents will severely attack PVDF at room temperature. Fuming nitric acid and concentrated sulfuric acid will cause softening. At temperatures approaching the service limit, strong caustic solutions will cause partial dissolution. Autoclavable if tanks are empty and externally supported.



POLYVINYLIDENE FLUORIDE

**Teflon PFA*** is translucent and slightly flexible. It has the widest temperature range of the fluoropolymers – from -270°C to +250°C – with superior chemical resistance across the entire range. Compared to TFE at 277°C, it has better strength, stiffness and creep resistance. PFA also has a low coefficient of friction and outstanding antistick properties and is flame-resistant.



TEFLON PFA

'Registered trademark of General Electric
+Registered trademark of Mitsui & Co., Ltd.
*or equivalent. Teflon and Tefzel are registered trademarks of DuPont.
**or equivalent. Halar is a registered trademark of Ausimont USA, Inc.
***Registered trademark of Elf Atochem

## Reference/Use & Care Guide

The following material includes general guidelines on the use and care of plastic laboratory products. For more information, contact your NALGENE Labware Dealer or Nalge Nunc International.

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## General Cleaning

NNI recommends using non-alkaline detergents for cleaning plastic labware, especially those products made of polycarbonate, which is particularly sensitive to alkaline attack.

NALGENE L-900 Liquid Detergent (Cat. No. 900) is designed to clean all plastics at a neutral pH. A 5% solution in water is usually sufficient but can be increased to 20% for stubborn residue or heavily-soiled labware. L-900 Detergent can be used in automatic washers for lightly- to normally-soiled items.

Soak the labware in the detergent for up to 3 hours, then gently wash with a cloth or sponge. Soak heavily-soiled items in a 5 to 20% concentration in water for 4 or more hours prior to washing. Rinse with tap water and then distilled water.

- Do not use abrasive cleaners or scouring pads on any plastic labware.
- Periodically disassemble and clean spigots and threads on bottles and closures to prevent salt build-up, which can cause leakage.
- Most plastics, particularly the polyolefins (LDPE, HDPE, PP, PMP and PPCO) have non-wetting surfaces that resist attack and are easy to clean.

### Dishwashers

Labware washing machines can be used with all resins except LLDPE, acrylic and PS, due to temperature limitations.

### Sp cial note on polycarbonate (PC)

**Repeated washings in the dishwasher weaken the exceptional strength of PC. PC labware that has been exposed to high stresses (such as those caused by centrifugation or use in vacuum chambers) should always be washed by hand using a mild, neutral pH, non-abrasive detergent without sheeting agents, such as NALGENE L-900.**

Keep the dishwasher cycle time to a minimum. Use the plastics cycle and set the water temperature at 135°F (57°C) or lower. Remove the labware as soon as possible after cooling is complete. Avoid excessive abrasion of plastics by covering metal spindles with soft material such as plastic tubing. Plastic labware should be weighted down and held in place with accessory racks.

### Ultr sonic Cleaners

Ultrasonic cleaning units may be used to clean labware as long as the labware does not rest directly on the transducer diaphragm.

## Special Problems

### Greases and Oils

For many applications, washing with a mild detergent will remove greases and oils. When more rigorous cleaning is needed, organic solvents may be used with caution. Extended exposure to these solvents may cause some swelling of polyolefins. Rinse off all solvents before using labware. Use only alcohols on PC, PSF, PS and PVC; other organic solvents will attack these plastics. Do not use organic solvents with acrylic.

### Organic Matter

Chromic acid solution will remove organic matter, but will eventually embrittle plastics. To minimize embrittlement, soak plastic for no more than 4 hours. The following formula is the recommended cleaning agent:

Dissolve 120 grams of sodium dichromate ($Na_2Cr_2O_7 \cdot 2H_2O$) in 1000 ml tap water. Carefully add 1600 ml concentrated sulfuric acid. Note: Because this solution generates considerable heat, we recommend external cooling. Do not mix in a plastic container.

This solution is designed to produce an excess of dichromate in the form of a precipitate which actually extends the useful life of chromic acid and dissolves as needed. This chromic acid solution can be used repeatedly until it begins to develop a greenish color, indicating a loss of potency. As a result of the excess dichromate built into this formula, the solution lasts much longer than commercially-available solutions.

Sodium hypochlorite solutions (bleach) are also effective in removing organic matter. Use at room temperature.

### Centrifuge Ware

After centrifugation, loosen pellets by presoaking the tube or bottle overnight in a mild detergent solution (we recommend NALGENE L-900). Do not soak PC centrifuge ware in alkaline detergents. If the pellet contains microbiological or hazardous material, refer to Hazardous Matter section. After soaking, use a pipet or soft rubber policeman to further loosen the pellet. A soft bristle brush may be used if care is taken not to scratch the plastic.

## Trace Level Cleaning

**Summary of Average Element Content of 12 Plastics and Borosilicate Glass[1]**

| Material | No. of Elements | Total Conc., ppm | Major Constituents |
|---|---|---|---|
| PS | 8 (8 N.D.*) | 4 | Na, Ti, Al |
| PSF | 16 (12 N.D.) | 17 | Na, Fe, Ca |
| TFE | 24 | 19 | Ca, Pb/Fe, Cu |
| LDPE | 18 | 23 | Ca, Cl, K |
| PC | 10 | 85 | Cl, Br, Al |
| PMP | 14 | 178 | Ca, Mg, Zn |
| FEP | 25 | 241 | K, Ca, Mg |
| PVC-tubing | 9 | 280 | Fe, Zn, Sb |
| PP | 21 | 519 | Cl, Mg, Ca |
| HDPE | 22 | 654 | Ca, Zn, Si |
| ETFE | 32 | 1,007 | Cl, Pb, Si |
| PVC-rigid | 7 (11 N.D.) | 2,541 | Sn, Ca, Mg |
| Borosilicate Glass | 14 | 497,249 | Si, B, Na |

*N.D. = Not Detected

NOTE: Values listed in the chart above represent typical contents for major constituents. Various grades of plastics may vary from these values.

[1]Selection and Cleaning of Plastic Containers for Storage of Trace Element Samples, John R. Moody and Richard Lindstrom, ANALYTICAL CHEMISTRY, Vol. 49, Page 2264, December 1977.

As the chart "Summary of Average Element Content of 12 Plastics and Borosilicate Glass" shows, for most trace metal analysis, plastic is generally "cleaner" or less contaminated than glass or other materials. However, plastic does contain trace levels of certain metals. To minimize potential low-level contamination, remove these metals or leach them from plastic by soaking in 1N HCl and rinsing in distilled water. For extremely precise work, use HCl, followed by soaking in 1N HNO3 and rinsing in distilled water. Soaking time may vary according to individual needs, but plastic should be soaked no longer than 8 hours. If more rigorous cleaning is desired, increase the concentration of acids used. **Caution:** concentrated nitric acid is a strong oxidizing agent and will embrittle many plastics.

## Interpretation of Chemical Resistance

The Chemical Resistance Chart and Chemical Resistance Summary Chart that follow are general guidelines only. Because so many factors can affect the chemical resistance of a given product, you should test under your own conditions. If any doubt exists about specific applications of NALGENE products, please contact Technical Service, Nalge Nunc International, Box 20365, Rochester, New York 14602-0365, or call (800) 625-4327, Fax (800) 625-4363. International customers, contact our International Department at +1 (716) 264-3898, Fax +1 (716) 264-3706. In Europe, contact Nalge (U.K.) at +44 (0) 1432 26393, Fax +44 (0) 1432 351923.

## Additional Chemical Resistance Information

This chemical resistance chart is to be used for all labware including containers up to 50L. For NALGENE centrifugeware or UltraPlus centrifuge ware please refer to those charts in this catalog.

For chemical resistance of PETG (polyethylene terephthalate copolyester), see below.

For NALGENE fluorinated containers, including fluorinated high-density polyethylene (FLPE) and fluorinated polypropylene (FLPP), see inside back cover.

## Effects of Chemicals on Plastics

Chemicals can affect the strength, flexibility, surface appearance, color, dimensions or weight of plastics. The basic modes of interaction which cause these changes are: (1) chemical attack on the polymer chain, with resultant reduction in physical properties, including oxidation; reaction of functional groups in or on the chain, and depolymerization; (2) physical change, including absorption of sol-vents, resulting in softening and swelling of the plastic; permeation of solvent through the plastic,and dissolution in a solvent, and (3) stress-cracking from the interaction of a "stress-cracking agent" with molded-in or external stresses. Also see "Chemical Resistance Classification".

The reactive combination of compounds of two or more classes may cause a synergistic or undesirable chemical effect. Other factors affecting chemical resistance include temperature, pressure and internal or external stresses (e.g., centrifugation), length of exposure and concentration of the chemical. As temperature increases, resistance to attack decreases.

Mixing and/or dilution of certain chemicals in NALGENE labware can be potentially dangerous. There active combination of different chemicals or compounds of two or more classes may cause an undesirable chemical effect or result in an increased temperature which can affect chemical resistance (as temperature increases, resistance to attack decreases). Other factors affecting chemical resistance include pressure and internal or external stresses (e.g., centrifugation), length of exposure and concentration of the chemical.

## Environmental Stress-Cracking

Environmental stress-cracking is the failure of a plastic material in the presence of certain types of chemicals. This failure is not a result of chemical attack. Simultaneous presence of three factors causes stress-cracking: tensile strength, a stress-cracking agent and inherent susceptibility of the plastic to stress-cracking.

Common stress-cracking agents are detergents, surface active chemicals, lubricants, oils, ultra-pure water and plating additives such as brighteners and wetting agents. Relatively small concentrations of stress-cracking agent may be sufficient to cause cracking.

**Mixing and/or dilution of certain chemicals may result in reactions that produce heat and can cause product failure. Pre-test your specific usage and always follow correct lab safety procedures.**

**ATTENTION:** Please be aware that, although several polymers may have excellent resistance to various flammable organic chemicals and solvents, OSHA H CFR 29 1910.106 for flammable and combustible materials, or other local regulations, may restrict the volumes of solvents which may legally be stored in an enclosed area.

## Caution

Do not store strong oxidizing agents in plastic labware except that made of FEP or PFA. Prolonged exposure causes embrittlement and failure. While prolonged storage may not be intended at time of filling, a forgotten container will fail in time and result in leakage of contents. Do not place any plastic labware in a flame.

*First letter of each pair applies to conditions at 20°C; the second to those at 50°C. At 20°C->EG<-at 50°C.*

## Resin Codes:

| | |
|---|---|
| ECTFE | Halar ECTFE* (ethylene-chlorotrifluoroethylene copolymer) |
| ETFE | Tefzel ETFE† (ethylene-tetrafluoroethylene) |
| FEP | Teflon FEP† (fluorinated ethylene propylene) |
| HDPE | high-density polyethylene |
| LDPE | low-density polyethylene |
| PC | polycarbonate |
| PETG | polyethylene terephthalate copolymer |
| PFA | Teflon PFA† (polyfluoroalkoxy) |
| PMP | polymethylpentene |
| PP | polypropylene |
| PPCO†† | polypropylene copolymer |
| PS | polystyrene |
| PSF | polysulfone |
| PVC | polyvinyl chloride |
| PVDF | polyvinylidene fluoride |
| TFE | Teflon TFE† (tetrafluoroethylene) |
| TMX | Thermanox |
| PMX | Permanox |

*Halar is a registered trademark of Ausimont USA, Inc.

†Or equivalent. Teflon and Tefzel are registered trademarks of DuPont.

††PPCO has replaced polyallomer (PA) in all products.

| CHEMICAL | LDPE | HDPE | PP | PPCO | PMP | PETG | FEP | TFE | PFA | ECTFE | ETFE | PC | RIGID PVC | FLEX. PVC | PSF | PS | PVDF | TMX | PMX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,4-Dioxane | GF | GG | FN | GF | GF | – | EE | EE | EE | EF | EF | NN | NN | FN | GN | NN | NN | EF | FN |
| 2,2,4-Trimethylpentane | FN | FN | FN | FN | FN | – | EE | EE | EE | EG | EG | NN | NN | NN | GF | NN | EE | – | FN |
| 2-Methoxyethanol | EG | EE | GE | EE | EE | FN | EE | EE | EE | EG | EG | NN | FN | FN | NN | NN | EE | G- | EE |
| 2-Propanol | EE | EE | EE | EE | EE | – | EE | EE | EE | EE | EE | EE | EF | GN | GF | EG | EE | EN | EE |
| Acetaldehyde | GN | GF | GN | GN | GN | – | EE | EE | EE | GF | EF | NN | NN | NN | NN | NN | NN | – | GN |
| Acetamide, Sat. | EE | EE | EE | EE | EE | – | EE | EE | EE | EE | EE | NN | NN | NN | NN | EE | GN | EG | EE |
| Acetic Acid, 05% | EE | EE | EE | EE | EE | FN | EE | EE | EE | EE | EE | EG | EF | EG | EE | EG | EE | EG | EE |
| Acetic Acid, 50% | GF | EG | EE | EE | EE | NN | EE | EE | EE | EG | EE | GF | EN | FN | EE | GG | EE | EG | EE |
| Acetic Acid, Glacial | GN | GG | EG | EG | GG | NN | EE | EE | EE | EE | EE | NN | EN | NN | EE | FN | EG | EG | EG |
| Acetic Anhydride | NN | FF | GF | GF | EG | – | EE | EE | EE | EE | EE | NN | NN | NN | NN | NN | NN | – | EG |
| Acetone | NN | NN | GN | GG | EE | NN | EE | EE | EE | EG | GN | NN | NN | NN | NN | NN | NN | FN | EE |
| Acetonitrile | EE | EE | EG | FN | FN | – | EE | EE | EE | EE | EE | NN | NN | NN | NN | NN | GG | – | FN |

E - No damage after 30 days of constant exposure.
G - Little or no damage after 30 days of constant exposure.
F - Some effect after 7 days of constant exposure.
N - Immediate damage may occur. Not recommended for continuous use.

# Reference • Physical Properties of NALGENE® Labware

| | Max. Use Temp. (°C)[1] | HDT[1] Temp. (°C) | Brittleness Temp. (°C)[13] | Transparency | Microwaveability[2] | Autoclaving | Sterilization[4] Gas | Dry Heat | Radiation | Disinfectants | Specific Gravity | Flexibility | Permeability (cc-mil/100in²-24 hr. atm) N₂ | O₂ | CO₂ | Water Absorption (%) | Non Cytotoxicity[6] | Suitability for Food and Bev. Use[7] Rating | Reg. Part 21 CFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETFE | 150 | 104 | -105 | Translucent | Yes | Yes | Yes | Yes | Yes | Yes | 1.7 | rigid | 30 | 100 | 250 | 0.03 | Yes | Yes | – |
| ECTFE | 150 | 119 | -105 | Translucent | Yes | Yes | Yes | Yes | No | Yes | 1.69 | rigid | 18 | 25 | 110 | 0.01 | Yes | Yes | – |
| FEP | 205 | 158 | -270 | Translucent | Marginal[3] | Yes | Yes | Yes | No | Yes | 2.15 | excel | 320 | 750 | 2200 | <0.01 | Yes | Yes | 177.1550 |
| FLPE | 120 | 65 | -100 | Translucent | No | No | Yes | No | Yes | Yes | 0.95 | rigid | 42 | 185 | 580 | <0.01 | – | Yes[8] | 177.1520 |
| HDPE | 120 | 65 | -100 | Translucent | No | No | Yes | No | Yes | Yes | 0.95 | rigid | 42 | 185 | 580 | <0.01 | Yes | Yes[9] | 177.1520 |
| LDPE | 80 | 45 | -100 | Translucent | Yes | No | Yes | No | Yes | Yes | 0.92 | excel | 180 | 500 | 2700 | <0.01 | Yes | Yes[9] | 177.1520 |
| PC | 135 | 138 | -135 | Clear | Marginal[3] | Yes[5] | Yes | No | Yes | Some | 1.2 | rigid | 50 | 300 | 1075 | 0.35 | Yes | Yes | 177.1580 |
| PEI | 170 | 210 | – | Clear Amber | Yes | Yes | Yes | – | Yes | Yes | 1.27 | rigid | 19 | 37 | 171 | 0.25 | – | Yes | 177.1595 |
| PET | 150 | 75 | -60 | Transparent | – | No | Yes | No | Yes | Some | 1.2 | mod | 0.7-1.0 | 3-9 | 15-25 | 0.25 | – | – | – |
| PETG | 70 | 70 | -40 | Clear | Yes | No | Yes | No | Yes | Yes | 1.27 | mod | 10 | 25 | 80 | 0.15 | Yes | Yes[10] | 177.1315 |
| PFA | 260 | 166 | -270 | Translucent | Yes | Yes | Yes | Yes | No | Yes | 2.15 | excel | 291 | 881 | 2260 | <0.03 | Yes | No | – |
| PK | 220 | 218 | -40 | Opaque | Yes | Yes | Yes | – | Yes | Some | 1.24 | rigid | – | 0.2 | 1.6 | 0.45 | – | – | – |
| PMMA | 50 | 93 | 20 | Clear | No | No | No | No | Yes | Some | 1.2 | rigid | – | – | 20 | 0.35 | Yes | – | – |
| PMP | 175 | 85 | 20 | Clear | Yes | Yes | Yes | Yes | No | Yes | 0.83 | rigid | 1100 | 4500 | – | 0.01 | Yes | Yes[12] | 177.1520 |
| PP | 135 | 107 | 0 | Translucent | Yes | Yes | Yes | No | No | Yes | 0.9 | rigid | 48 | 240 | 800 | <0.02 | Yes | Yes | 177.1520 |
| PPCO | 121 | 90 | -40 | Translucent | Marginal[3] | Yes | Yes | No | No | Yes | 0.9 | mod | 45 | 200 | 650 | <0.02 | Yes | Yes | 177.1520 |
| PPO | 100 | 149 | -170 | Opaque | – | Yes | – | No | Yes | No | 1.06 | rigid | – | 1000 | – | 0.06 | – | Yes | 177.2460 |
| PS | 90 | 105 | 20 | Clear | No | No | Yes | No | Yes | Some | 1.05 | rigid | 55 | 300 | 1150 | 0.05 | Yes | Yes | 177.1640 |
| PSF | 165 | 174 | -100 | Clear Yellow | Yes | Yes | Yes | Yes | Yes | Some | 1.24 | rigid | 55 | 300 | 700 | 0.3 | Yes | Yes | 177.1655 |
| PUR | 82 | <23 | -70 | Clear | No | No | Yes | No | Yes | Yes | 1.2 | excel | 41-119 | 75-827 | 450-1650 | 0.03 | Yes | – | – |
| PVC (rigid) | 70 | 90 | -30 | Clear | Yes | No | Yes | No | No[3] | Some | 1.34 | rigid | 2-20 | 4 | 4 | 0.15-0.75 | Yes | Yes[12] | – |
| PVC (tubing) | 82 | -32 | -32 | Clear | Yes[14] | Yes | Yes | No | No | Some | 1.34 | excel | – | 100-1400 | 20-12,000 | 0.15-0.75 | Yes | Yes[12] | – |
| PVDF | 150 | 139 | -62 | Translucent | – | Yes | Yes | No | No | Yes | 1.75 | rigid | 9 | 14 | 505 | 0.05 | Yes | Yes | 177.2510 |
| SAN | 93 | 104 | 20 | Clear | – | No | Yes | No | – | No | 1.08 | rigid | – | – | – | 0.2 | – | – | – |
| Silicone | 200 | -46 | -117 | Translucent | – | Yes | Yes | – | Yes | Yes | 1.16 | excel | 43000 | 123000 | 312000 | 0.1 | Yes | Yes | 177.2600 |
| TPE | 121 | <23 | <-50 | Opaque | Yes | Yes | Yes | No | – | Some | 0.9 | excel | 31-145 | 86-646 | 800-8634 | 0.1-0.42 | Yes | – | – |
| TFE | 288 | 200 | -100 | Opaque | Yes | Yes | Yes | Yes | No | Yes | 2.20 | rigid | – | – | – | <0.01 | Yes | – | – |
| XLPE | 65 | 59 | -118 | Translucent | No | No | Yes | No | Yes | Yes | 0.93 | rigid | – | – | – | <0.01 | Yes | – | – |
| Permanox® | 180 | 65 | -10 | Transparent | Yes | Yes | Yes | Yes | No | Yes | 0.84 | rigid | – | – | – | <0.01 | – | – | – |
| Thermanox® | 150 | 75 | -60 | Transparent | – | No | Yes | No | Yes | Some | 1.30 | mod | 0.7-1.0 | 3-6 | 15-25 | 0.25 | – | – | – |

1 Heat Deflection Temperature is the temperature at which a bar deflects 0.01 in. at 66 psig (ASTM D648). Materials may be used above Heat Deflection Temperatures in non-stress applications; see Max. Use Temp.

2 Ratings based on 5-minute tests using 600 watts of power on exposed, empty labware. CAUTION: Do not exceed Max. Use Temp., or expose labware to chemicals which heating causes to attack the plastic or be rapidly absorbed.

3 Plastic will absorb heat.

4 STERILIZATION:
- Autoclaving (121°C, 15 psig for 20 minutes) — Clean and rinse items with distilled water before autoclaving. (Always completely disengage threads before autoclaving.) Certain chemicals which have no appreciable effect on resins at room temperature may cause deterioration at autoclaving temperatures unless removed with distilled water beforehand.
- Gas — Ethylene Oxide, formaldehyde, hydrogen peroxide
- Dry Heat (160°C, 120 minutes)
- Disinfectants — Benzalkonium chloride, formalin/formaldehyde, ethanol, etc.
- Radiation — gamma irradiation at 25 kGy (2.5 MRad) with unstabilized plastic.

5 Sterilizing reduces mechanical strength. Do not use PC vessels for vacuum applications if they have been autoclaved. Refer to Use and Care Guidelines for NALGENE Labware, for detailed information on sterilizing.

6 "Yes" indicates the resin has been determined to be non-cytotoxic, based on USP and ASTM biocompatibility testing standards utilizing an MEM elution technique on a WI38 human diploid lung cell line.

7 Resins meet requirements of CFR21 section of Food Additives Amendment of the Federal Food and Drug Act. End users are responsible for validation of compliance for specific containers used in conjunction with their particular packaging applications.

8 Acceptable for aqueous foods only, at temperatures up to 121°C/250°F. Not sanctioned for use with alcoholic or fatty foods at any temperature.

9 Acceptable for:
- Nonacid, aqueous products; may contain salt, sugar or both (pH above 5.0)
- Dairy products and modifications; oil-in-water emulsions, high or low fat
- Moist bakery products with surface containing no free fat or oil
- Dry solids with the surfaces containing no free fat or oil (no end-test required) and under all conditions as described in Table 2 of FDA Regulation 177.1520 except condition A – high temperature sterilization (e.g. over 100°C/212°F)

10 Acceptable for:
- Alcoholic foods containing not more than 15% (by volume) alcohol; fill and storage temperature not to exceed 49°C (120°F)
- Non-alcoholic foods of hot fill not to exceed 82°C (180°F) and 49° C (120°F) in storage.
- Not suitable for carbonated beverages or beer or packaging food requiring thermal processing.

11 Straight-sided jars, beakers and graduated cylinders only.

12 Acceptable for aqueous, oil, dairy, acidic, and alcoholic foods up to 71°C/160°F.

13 The brittleness temperature is the temperature at which an item made from the resin may break or cracked if dropped. This is not the lowest use temperature if care is exercised in use and handling.

14 The tubing will become opaque from absorbed water.

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